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November 27, 1974

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SIS Job No. 17530-A

Reference: Results of Sampling and Analyses of Water and Bottom Samples
from the U. S. Steel South Works Plant, Chicago, Illinois

Gentlemen:

This is a letter report in which we are presenting the results of our investigation of the water and bottom materials in the North and South Slips at your South Works Plant in Chicago. This investigation included borings into the bottom materials at five locations and the taking of water and bottom samples at these same five locations. These samples were then subjected to analyses which were dominantly chemical in nature. The borings and samplings were carried out on October 9-10, 1974.

In addition to discussing the sampling operations at the site, this report includes: 1) Location Diagrams, 2) Boring and Sampling Logs, 3) Results from the Chemical Analyses of the Water Samples and the Methods Used, 4) Results from the Chemical Analyses of the Bottom Samples and the Methods Used, 5) Results from Special Sedimentation Tests, 6) Results from Special Chemical Tests, and 7) Comparative Results from Illinois EPA Water Sampling Stations Located near the South Works Plant.

Sampling Locations

The enclosed Location Diagrams, Figures 1 and 2, show the sampling locations and the sample reference numbers. Both water and bottom samples were obtained at each sampling location. The station numbers shown on the location diagrams refer to numbers emblazoned along the slips in large numerals; they indicate distances from a fiduciary mark.

Sampling Observations

Water Depths and Temperatures

Water depths were measured using a weighted steel tape, and are shown on the boring logs. They were found to range between 15 and 37 feet. Water temperatures were measured in the compositing container and are shown on the logs.

*Rec'd
12/3/74
WSS*

Bottom Materials

With the exception of sampling location No. 4, the upper portion of the bottoms was found to consist of a soft, black and brown colored material. This was in turn found to be underlain by a very hard, gray, silty, sandy clay (till). (The existence of this clay was not verified at the sampling location No. 3 because inadequate anchorage for the barge prevented auger rig operations.) At location No. 4, no soft bottom materials were encountered; however, the dredge brought up samples of broken concrete, sand, gravel and clay. The sand, gravel and clay was brown in color and clearly more dense than the soft, black, bottom materials.

At location No. 3, two types of soft materials were recovered by the dredge: one was a gray and brown, silty fine sand, and the other was a gray black material.

Boring and Sampling Logs are enclosed which show the depths of the interfaces between different materials and show the types of materials found.

Sampling Procedures

The sampling operation consisted of two phases. One was the obtaining of composite water samples, while the other was the recovery of the bottom materials.

Water Sampling

Nine water samples were obtained at each sampling location with a Kemmerer 1600 cc water sampler. The ends of this brass sampler are open until the desired depth has been reached; at this point, triggering causes rubber stoppers to seal the ends, thereby positively containing the water sample. After the sampler was lowered to the desired depth, it was triggered and then raised to the work barge and the contents transferred.

At each sampling location, water samples were taken at three positions across the slip. At each of these three positions, three samples were recovered at different depths, as indicated on the sampling logs. At each of these positions, one near each edge and one in the approximate center of the slip, oil and grease samples were taken directly from the sampler to reduce the adsorption of the oil and grease by additional surfaces of utensils and containers. The remainder of the sample was then placed in the compositing (mixing) container (made of polyethylene). After mixing, composite samples were removed using a stainless steel sampling ladle and transferred to sample containers. A special plastic bottle containing CuSO_4 was also filled; this sample was for subsequent phenol analysis.

The influence of the tug propellers and the tug and barge movements on the water composition is somewhat unknown. The sampling location with the shallowest water was No. 2 with a depth of 15.5 ft. However, maneuvering by the tug could have caused propeller backwash currents to reach yet shallower regions near the sides of the channels. As a consequence, suspended matter in the water samples might be higher than it would have been in the absence of the tug's propellers. With reference to Table 1, which presents the chemical analyses data for the water samples, most parameters would be increased by bottom disturbances; the parameters which might be only slightly modified by disturbance of the soft bottoms are: 1) Chloride, Dissolved 3) Electrical Conductivity 11) pH 13) Soluble Phosphate 15) Filterable Residue and 17) Sulfate, Dissolved. (The numbers refer to the number of the test in Table 1.)

Bottom Sampling

Bottom sampling was performed with a truck-mounted auger rig which in turn was mounted on a work barge. The work barge was attended at all times by a tug boat. The procedures and supplementary equipment utilized are discussed below.

The initial intent of the bottom sampling operation was to recover a continuous sample of the soft bottom materials and of the natural soils immediately beneath them at each location. The first method attempted required that a 3-in. diameter, 10 ft. long shelby tube be driven through the soft bottoms and into soft clay which was thought to exist beneath the soft bottom materials. This method had been successfully utilized by Soil Testing Services, Inc. in the Calumet River, and preliminary information led us to believe it would work successfully here also, the soft clay functioning as a plug to hold the soft bottom materials in the tube during raising of the tube.

The shelby tube sampling method was attempted at location No. 1. However, it had to be abandoned because the tube could not be driven into the hard clay which was present beneath the soft surface materials. The depth at which the hard clay (till) layer was encountered suggests that in previous dredging operations, the softer clay commonly found in this area had been removed from the bottom. Samples of the till material were recovered utilizing a 2-in. split-spoon sampler.

A second sampling technique was employed to recover a composite sample of soft bottom material from a depth immediately below the soft bottom: water interface down to the natural materials. This technique consisted of dropping a torpedo on an A-rod; this assembly fell until stopped by the natural bottom materials. After a period of time during which the void created by the torpedo could be filled by the natural flow of the soft materials, a steel casing was placed around the A-rod and torpedo. The torpedo was then raised and a composite sample of the bottoms was recovered. This method of sample recovery was utilized at sampling location No. 1.

Because of the inability to firmly secure the barge at all locations and because of the great depth of the water and the large thickness of soft materials encountered, torpedo sampling techniques were abandoned in favor of the clam shell bucket after a conference with Mr. Dave Sutton, of your South Works staff, and Dr. Walter Jackson, of your Pittsburgh office.

During this conference, the objectives of the sampling operation were evaluated. It was decided that by repeatedly dropping the clam bucket over the working platform on the barge at the same point, a composite sample of the upper 2 to 3 ft. of the soft materials could probably be obtained. The location of the hard clay materials would be determined by repeated driving of the 2-in. split-spoon. In no case was natural material, hard or soft, found to extend above the 28 ft. depth mark.

At each sampling location, the contents of each successive clam shell bucket load were deposited on the barge and portions transferred to glass sample bottles, thereby creating a composited bottom sample from each sampling location.

At sampling location Nos. 2, 4 and 5, natural bottom materials were recovered utilizing the split-spoon sampling method while the soft bottom materials were recovered utilizing the clam shell bucket. At sampling location No. 3, located in the open waters of the harbor area, significant drifting of the barge occurred because secure moorings were not available; no split-spoon samples could be obtained at this location. Bottom samples were recovered utilizing the clam bucket, however.

Both the bottom materials and the composite water samples were immediately placed in a wooden box and covered with ice. These were then returned to our laboratories for refrigeration at the end of each of the two sampling days.

Specific Gravity

Specific gravity, as used here, refers to the specific gravity of the particles which make up the non-aqueous substance of the bottom. The determination averages the specific gravities of all components present. The specific gravities were found to be as follows:

<u>Sample #1</u>	<u>Sample #2</u>	<u>Sample #3</u>	<u>Sample #4</u>	<u>Sample #5</u>
2.98	2.72	2.89	2.74	2.72

(These determinations were made according to ASTM Specification D 854.)

Samples 2, 4 and 5 show specific gravities which are similar to that of sand or clayey inorganic soils, while those of samples 1 and 3 are considerably higher than normally found in soils. These high values are undoubtedly due to iron oxide present in the samples.

Chemical Analyses

Water Samples

The water sampling operation has been described. The containers into which the composited samples were transferred were one-gallon glass bottles (except that separate containers were used for samples for oil and grease analysis and for samples for phenol analysis). These bottles had been detergent-cleaned, acid-rinsed and DI-water-rinsed. They were capped with lids gasketed with Saranwrap.

The water samples were iced at the site and were subsequently maintained in an iced or refrigerated condition until analysis of all parameters had been completed. The results of the chemical testing of the composited water samples are given in Table 1 with the methods used being given in Table 2.

Bottom Samples

The bottom sampling operation has been described. The containers into which the composited samples were transferred were one-gallon glass bottles that had been detergent-cleaned, acid-rinsed and DI-water-rinsed. They were capped with lids gasketed with Saranwrap.

The bottom samples were iced at the site and were subsequently maintained in an iced or refrigerated condition until analysis of all parameters had been completed. Sub-samples were removed for cyanide and total Kjeldahl nitrogen analysis immediately after the return of the samples to the laboratory; these were stabilized for temporary storage by the addition of base and acid, respectively, and by refrigeration.

The results of the chemical testing of the bottom samples are given in Table 3; the methods of analysis used are presented in Table 4. The results are given in terms of dry weight since this is the standard method for presentation of composition data for solid materials.

Efforts were made to assure that the sub-samples truly represented the average composition of the materials in the one-gallon bottles. Of the bottom samples, only sample No. 4 was somewhat recalcitrant in that some rocks failed to decompose completely under fuming sulfuric acid reflux. As a consequence, the concentrations of some of the heavy metals given for sample No. 4 may be low.

We should perhaps re-emphasize that the basic methods used in analytical chemistry for the determination of a given component are all subject to interferences caused by the presence of other components. Though many different recourses exist to eliminate or avoid interferences, it is not usually clear, in the case of an unknown sample, which recourse should be followed. Because of this problem, the chemical profession has attempted to present optimized methods for the analysis of any given material where repeated tests of the material are necessary. Up to now, such explicit methods have not been developed for bottom materials in commercial waterways.

Special Testing of Bottom Samples

In order to partially evaluate the rate at which re-suspended bottom materials would settle out, the following procedure was carried out. This procedure was, of course, an approximation to the operations expected in the planned settling basin for the dredge water slurry.

A composite bottom sample was prepared containing approximately equal amounts of dry solids from each of the five bottom samples. The compositing was done with the wet samples in order to avoid changes that might influence settling rates. After this composited bottom sample was mixed, a portion containing approximately 75 grams of dry material was removed and transferred into a one-liter, glass, graduated cylinder (60 mm I.D.). Deionized water was then added to bring the total volume to 1 liter. This mixture was thoroughly agitated until a uniform suspension was obtained; it was then set aside to allow settling to occur.

After approximately 75 hours, the upper $\frac{1}{2}$ -liter of the suspension was carefully pipetted off, and a determination made of the total solids present in the portion removed. The amount was found to be 0.5% of the total weight of dry solids originally introduced into the graduated cylinder; this meant that 1.0% of the initial weight of dry solids in the upper $\frac{1}{2}$ -liter remained after 3 days or that 99.0% had settled out in that period. The upper $\frac{1}{2}$ liter was contained in a cylindrical volume extending down from the water surface to a depth of about 6.8 in. (~ 17 cm.).

The above procedure utilized deionized water as the suspending agent rather than water samples from the slips or harbor. As a consequence, the ionic content was considerably less than would be the case of actual dredging operations; for example, Lake Michigan water has an electrical conductivity of 270-280 micromho/cm (25°C.) whereas, the upper $\frac{1}{2}$ -liter of settled slurry showed a value of 155 micromho/cm (25°C.). Generally, higher ionic contents in water produce faster sedimentation rates because of their greater ability to induce coagulation of the finer suspended particles. Thus, it might be anticipated that higher rates of settling than found in the above laboratory test will be found in the actual dredging operations.

In Table 5, are tabulated the electrical conductivity and pH values found in slurries prepared by mixing one weight of wet bottom material with two weights of deionized water. (This is a standard test for chemical evaluation of unknown soil samples.) The pH values are similar to those frequently found, not far from neutrality but on the alkaline side. The bottom material from the east end of the North Slip (sample No. 4) is different from the remaining samples in that its pH of 10 is well on the basic side; this difference was also apparent in the whitish appearance of bottom No. 4 in contrast to the blackish color of bottom Nos. #1-3, 5. On the other hand, the north end of the South Slip (sample No. 1) yields the highest electrical conductivity value. (This value is, however, actually much smaller than most well water samples in this area.)

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In Table 6, are tabulated some parameters for water samples obtained in the area of the present site on the far south side of Chicago. This data was obtained from the 1972 and 1973 Water Quality Network Data as summarized by the Illinois Environmental Protection Agency. It is clear that with respect to the parameters, electrical conductivity, chloride content and chemical oxygen demand, only the water samples from the South Slip exceed the values obtained from nearby points in Lake Michigan.

If you have any questions concerning this report, please do not hesitate to contact us.

Yours truly,

SOIL TESTING SERVICES, INC.

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Chemical Analyses of Compositated Water Samples*
Taken on October 9-10, 1974

United States Steel Corporation

	South Slip		Harbor	North Slip	
	North End Sample #1	South End Sample #2	Sample #3	East End Sample #4	West End Sample #5
1. Chloride, Dissolved, mg/l	23.2	15.9	7.8	8.6	8.4
2. Cyanide, mg/l	0.095	0.036	0.012	<0.008	<0.008
3. Electrical Conductivity, micromhos/cm @ 25°C. (Specific Conductance)	360	310	270	275	245
4. Iron, Total, mg/l	0.64	0.36	0.17	0.49	0.25
5. Nitrogen, Ammonia, mg/l (NH ₃ -N)	1.52	1.06	0.30	0.23	0.18
6. Nitrogen, Nitrate, mg/l (NO ₃ -N)	0.22	0.24	0.24	0.25	0.27
7. Nitrogen, Organic, mg/l (Organic N)	0.52	0.40	0.28	0.40	0.31
8. Oil and Grease, mg/l	7	7	8	11	35
9. Oxygen Demand, Biological, mgO ₂ /l (BOD ₅)	6.0	3.6	<1	<1	<1
10. Oxygen Demand, Chemical, mgO ₂ /l (COD)	11	7	4	10	5
11. pH (-log ₁₀ [H ⁺]) Temperature °C.	8.20 25.3°	8.18 25.3°	8.30 25.6°	8.11 25.9°	8.11 25.9°
12. Phenol, mg/l	0.034	0.007 ✓	<0.001	<0.001	<0.001
13. Phosphorus, Soluble Phosphate, mgP/l	0.04	0.02	0.02	0.02	0.01
14. Phosphorus, Total Phosphate, mgP/l	0.05	0.04	0.02	0.03	0.04

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Near Detection
Limit

Chemical Analyses of Composited Water Samples*
Taken on October 9-10, 1974

United States Steel Corporation

	South Slip		Harbor	North Slip	
	North End Sample #1	South End Sample #2	Sample #3	East End Sample #4	West End Sample #5
15. Residue, Filterable, mg/l (Dissolved Solids)	223	200	165	178	171
16. Residue, Total, mg/l, 105°C. Dry (Total Solids)	237	217	175	180	179
17. Sulfate, Dissolved, mg/l	35	29	22	24	23
18. Turbidity, Jackson Units	3	5	5	7	5

*See Table 2 for Methods of Analysis.

< means less than. Value indicates lower limit of detectability for the method used.

TABLE 2

Methods of Analyses for Composited Water Samples
Taken on October 9-10, 1974

United States Steel Corporation

ParameterMethodPreservationReference*

1. Chloride	Potentiometric Titration	Refrigeration	203, 203C
2. Cyanide	Pyridine: Barbituric Acid after Uncatalyzed, Acidic Distillation	Refrigeration; then 20 meg. NaOH/l in Lab plus refig.	207, 207A (Modified) 207C (Modified per ASTM Method D 2036-72)
3. Electrical Conductivity	Low Frequency Bridge with Platinized Electrodes	Refrigeration	154, 226
4. Iron, Total	Atomic Absorption after Acidification	Refrigeration until Acidification in Lab	129, 129A
5. Nitrogen, Ammonia	Alkaline Distillation	Refrigeration	212, 132, 132A, 135
6. Nitrogen, Nitrate	Brucine	Refrigeration	133, 213, 213C
7. Nitrogen, Organic	Alkaline Distillation after Acidic Mercuric Salt Digestion; Subsequent Titration	Refrigeration	135, 215
8. Oil and Grease <i>EPA recommends use of direct solvent extraction</i>	<i>Freon</i> n-Hexane Extraction after Separate Compositing on Site Directly into Glass Container	Refrigeration	209, 209A
9. Oxygen Demand, Biological	Sample Transferred to BOD Bottle in Lab	Refrigeration	141, 200B, 219
10. Oxygen Demand, Chemical	Sample Refluxed with Chromic Acid and Catalysts	Refrigeration	142, 200B, 220
11. pH	Glass Electrode with Standard Half-Cell, Salt Bridge and Very High Impedance Voltmeter	Refrigeration	144, 144A, 221

*Iron will be higher
after digestion**for water use
infrared technique
for measurement of petroleum oil*

TABLE 2 (continued)

Methods of Analyses for Composited Water Samples
Taken on October 9-10, 1974

United States Steel Corporation

<u>Parameter</u>	<u>Method</u>	<u>Preservation</u>	<u>Reference*</u>
12. Phenol	Portion of Full Composited Sample Transferred to PE Bottle Containing CuSO_4 on Site; 4-Aminoantipyrine Reagent and Extraction after Acidic Distillation	1.0 g/l $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ plus Refrigeration	222, 222A, 222C
13. Phosphorus, Soluble Phosphate	0.45 micron membrane Filtration, Acidic Persulfate Hydrolysis and Phospho Molybdate Blue Formation	Refrigeration	223, 223A, 223C, 223E
14. Phosphorus, Total Phosphate	Same as 13 But Without the Filtration	Refrigeration	223, 223C, 223E
15. Residue, Filterable	0.45 micron Filtration (Glass Fiber), Evaporation, Dry at 105°C .	Refrigeration	148, 148B, 224
16. Residue, Total	Evaporation and Dry at 105°C .	Refrigeration	148, 148A, 224, 224A
17. Sulfate, Dissolved	Nephelometric BaSO_4	Refrigeration	156, 156C
18. Turbidity	Percent White Light Transmitted; Comparison with Formazin Polymer Standards	Refrigeration	163, 163A

*Indicates a Section in Standard Methods for the Examination of Water and Wastewater, Thirteenth Edition, 1971; APHA, AWWA, WPCF; Publication Office: American Public Health Association, 1015 18th Street, N.W., Washington, D.C. 20036, unless otherwise indicated.

TABLE 3

November 8, 1974
Page 1 of 2Chemical Analyses of Bottom Samples*
Taken on October 10, 1974United States Steel Corporation

	South Slip		Harbor	North Slip	
	North End Sample #1	South End Sample #2	Sample #3	East End Sample #4	West End Sample #5
1. Arsenic, mg/kg dry wt.	42	20	23	7	18
2. Barium, mg/kg dry wt.	111	72	94	29	53
3. Cadmium, mg/kg dry wt.	4.44	1.95	0.959	0.316	0.918
4. Cyanide, mg/kg dry wt.	23.40	12.20	4.60	0.90	1.95
5. Fluoride, mg/kg dry wt.	656	298	146	205	291
6. Iron, mg/kg dry wt.	202,000	118,000	134,000	26,100	65,100
7. Lead, mg/kg dry wt.	1283	444	314	61	373
8. Mercury, mg/kg dry wt.	1.390	0.440	0.177	0.047	0.820
9. Nitrogen, Total Kjeldahl, mg N/kg dry wt.	1,658	1,465	884	873	1,449
10. Oil and Grease, mg/kg dry wt.	49,250	21,751	4,902	1,628	15,867
11. Oxygen Demand, Chemical, mgO ₂ /g dry wt.	98.6	86.7	45.6	32.6	66.9
12. Selenium, mg/kg dry wt.	0.61	0.39	0.32	0.22	0.69
13. Silver, mg/kg dry wt.	2.06	0.81	0.83	0.32	0.57
14. Solids, Total Dry (105°C.) % ref. to wet wt.	39.75	49.07	56.72	80.97	52.17

open lake gravel + concrete

Chemical Analyses of Bottom Samples*
Taken on October 10, 1974United States Steel Corporation

	South Slip		Harbor	North Slip	
	North End Sample #1	South End Sample #2	Sample #3	East End Sample #4	West End Sample #5
15. Solids, Volatile (550°C.) % ref. to dry wt.	11.01	8.95	5.14	4.21	5.88
16. Zinc, mg/kg dry wt.	2,278	945	794	103	1,033

* See Table 4 for Methods of Analyses.

< means less than. Value indicates lower limit of detectability for the method used.

TABLE 4

Methods of Analyses of Bottom Samples
Taken on October 10, 1974

United States Steel Corporation

<u>Parameter</u>	<u>Method</u>	<u>Preservation</u>	<u>Reference*</u>
1. Arsenic	Fuming Sulfuric Acid Reflux; Atomic Absorption on Arsine Gas Generated by Borohydride Reduction	Refrigeration	104; AA Newsletter, 1973-4
2. Barium	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	105, 129, 129A, 211, 211(1)A
3. Cadmium	Fuming Sulfuric Acid Reflux; Atomic Absorption	Refrigeration	109, 109A, 129, 129A, 211, 211(1)A
4. Cyanide	Titration with Ag^+ after Sulfide removal and after Acidic Distillation without Catalysts	Refrigeration; then 30 meg. NaOH added to 25.0 g. wet sample and Refrigerated	120, 207, 207A, 207B
5. Fluorine	Distillation from Slurry with Sulfuric Acid; Ion Sensitive Electrode	Refrigeration	121, 121A, 121B, 208
6. Iron	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	124, 124D, 129, 129A, 211, 211(1)A
7. Lead	Fuming Sulfuric Acid Reflux; Atomic Absorption	Refrigeration	125, 125B, 129, 129A, 211, 211(1)A
8. Mercury	Flameless Atomic Absorption after Fuming Sulfuric Acid Reflux and H_2O_2 De-Coloriza- tion and Filtration	Refrigeration	Methods for Chemical Analysis of Water and Wastes, 1974, U.S. EPA, Mercury
9. Nitrogen, Total Kjeldahl	Digestion with Sulfuric Acid, Mercuric Sulfate and Na_2SO_4 followed by Distillation and Titration of NH_3	Refrigeration; then 120 meg. H_2SO_4 added to 25.0 g. wet sample and Refrigerated	132, 135, 212, 215, 216

TABLE 4 (continued)

Methods of Analyses of Bottom Samples
Taken on October 10, 1974

United States Steel Corporation

*Workup
by procedure
the next time?*

<u>Parameter</u>	<u>Method</u>	<u>Preservation</u>	<u>Reference*</u>
10. Oil and Grease	Soxhlet Extraction using n-Hexane	Refrigeration	209, 209A, 209C
11. Oxygen Demand, Chemical	Reflux with Chromic Acid and Catalysts and Titrate	Refrigeration	142, 200B, 220
12. Selenium	Fuming Sulfuric Acid Reflux; Atomic Absorption on H ₂ Se Gas Generated by Borohydride Reduction	Refrigeration	150; AA Newsletter, 1973-4
13. Silver	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	129, 129A, 152, 211, 211(1)A
14. Solids, Total Dry	Dried to Constant Weight at 105° C.	Refrigeration	148, 224, 224A
15. Solids, Volatile	Heat dried sample in Muffle Furnace at 550° C. for 1 hr.	Refrigeration	224, 224G
16. Zinc	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	165, 165A, 129, 129A, 211, 211(1)A

*Indicates a Section in Standard Methods for the Examination of Water and Wastewater, Thirteenth Edition, 1971; APHA, AWWA, WPCF; Publication Office: American Public Health Association, 1015 18th Street, N.W., Washington, D.C. 20036, unless otherwise indicated.

Special Chemical Analyses of Bottom Samples*
Taken on October 10, 1974

	South Slip		Harbor	North Slip	
	North End	South End		East End	West End
	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
Electrical Conductivity, micromhos/cm at 25°C. (Specific Conductance)	536	299	196	131	396
pH ($-\log_{10}[\text{H}^+]$)	8.81	8.12	8.75	10.02	7.70
Temperature °C.	25.1°	25.1°	25.2°	25.3°	25.6°

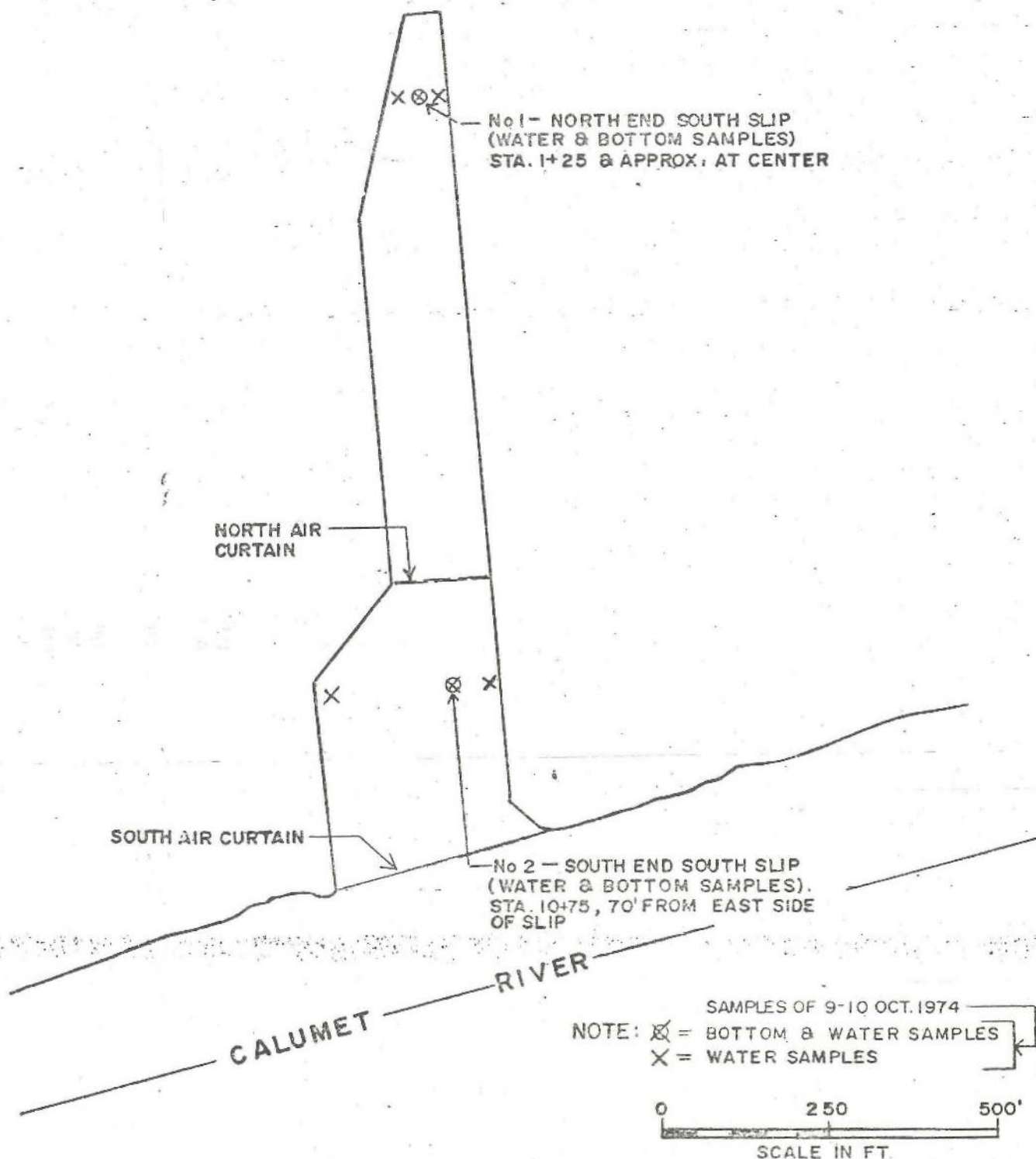
*These samples were prepared for analysis by shaking together for one hour one weight of bottom sample with two weights of deionized water.

TABLE 6

Water Quality Parameter Values from Nearby Sampling Points
 Source: State of Illinois, Environmental Protection Agency
 Water Quality Network 1973 Summary of Data
 (1972 Data in Parentheses)

United States Steel Corporation

<u>Lake Michigan</u>	<u>Electrical Conductivity @ 25° C. Mean Value</u> <u>Micromho/cm</u>	<u>Chloride</u>	<u>COD</u>
		<u>mg/l</u> <u>Mean Value</u>	<u>mgO₂/l</u> <u>Mean Value</u>
Breakwater at State Line, 0.3 mi. Offshore at 85th Street	283 (272)	9 (9)	- (5)
Mouth of Calumet River, Boat Sample	292 (277)	10 (9)	- (4)
Chicago 100th Street Beach at Bath House	285 (283)	9 (10)	- -
<u>Calumet River System</u>			
U.S. Route 41, Ewing Avenue Bridge, North Mouth Calumet River	343 (400)	- (28)	- (13)
130th Street Bridge, South of Lake Calumet; Calumet River	495 (517)	40 (61)	- (19)
Torrence Avenue Bridge at Burnham; Grand Calumet River	738 (920)	91 (101)	- (35)
I-94, Calumet Expressway Bridge at Dolton; Little Calumet River	603 (813)	55 (102)	- (45)

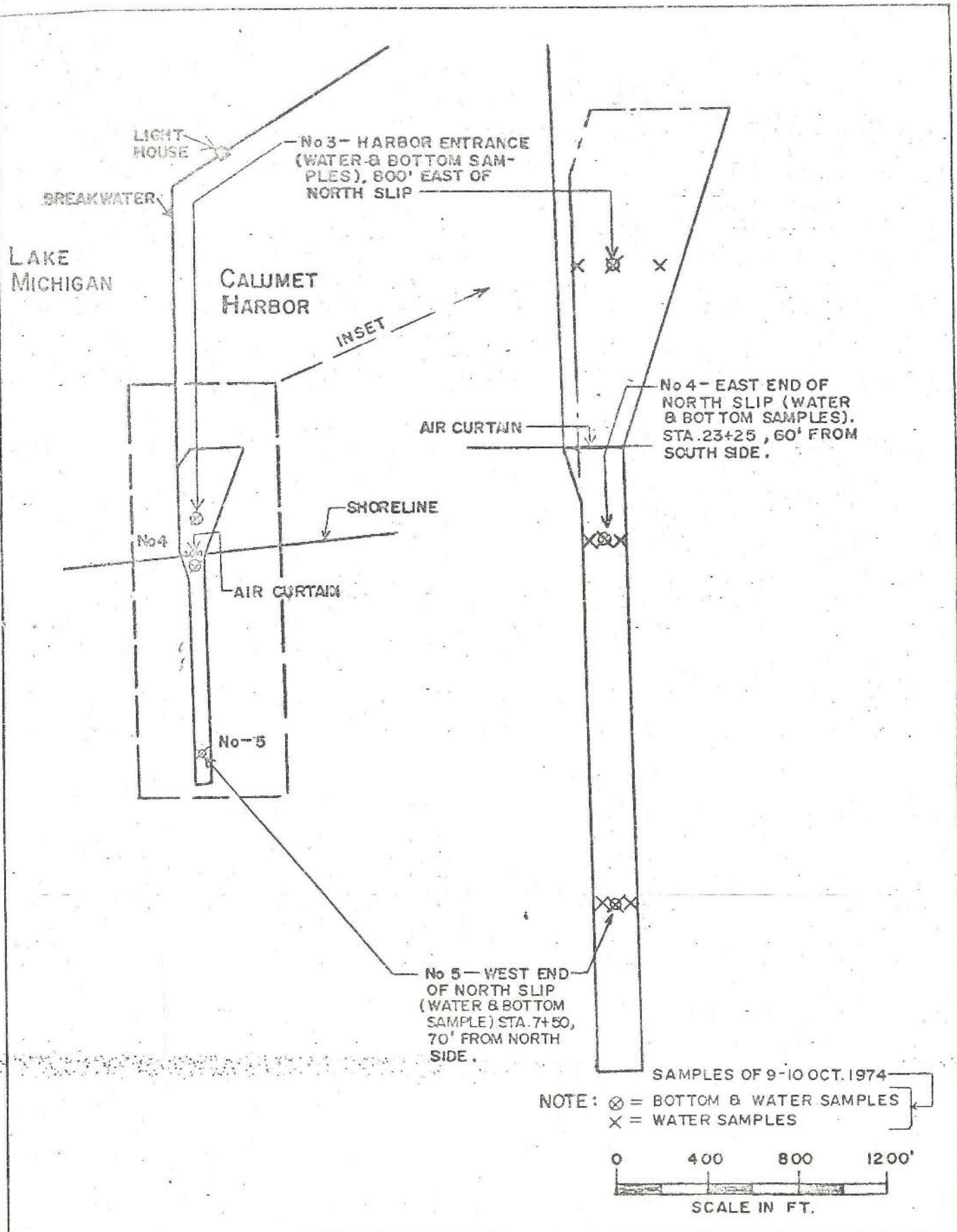


WATER & BOTTOM SAMPLING POINTS
 SOUTH VESSEL SLIP
 U. S. STEEL CORP. S. WORKS
 CHICAGO ILLINOIS



SOIL TESTING SERVICES, INC.
 111 PFINGSTEN ROAD
 NORTHBROOK ILLINOIS 60062

RE Z OCT., 1974 17530-A



WATER & BOTTOM SAMPLING POINTS
NORTH VESSEL SLIP
U.S. STEEL CORP., S. WORKS



SOIL TESTING SERVICES, INC.
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS 60062

REZ OCT., 1974 17530-A

OWNER U.S. Steel Corporation	LOG OF BORING NUMBER Southslip 10+75 approx. B-2 70' from East side of slip
PROJECT NAME North & South Slip Bottom Sampling	ARCHITECT-ENGINEER

SITE LOCATION South Works Plant, Chicago, Illinois					UNCONFINED COMPRESSIVE STRENGTH TONS/FT. ² 1 2 3 4 5 PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % X --- O --- Δ 10 20 30 40 50				
ELEVATION	DEPTH	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT. ³	STANDARD PENETRATION BLOWS/FT.	
	X					SURFACE ELEVATION		10 20 30 40 50	
10.0						Water (temp 180C)			
20.0						Soft, black bottom materials - Free fall of drilling rods			
30.0									
37.3		1-55	CL-ML			Silty, sandy clay, trace fine gravel gray - hard (CL-ML) Qp=4.5+		40+	
						End of Boring	*Calibrated Penetrometer		
Water samples were recovered at depths of 5, 10 and 14' near the edges and 7, 14 and 21' near center. Water depth is greater at this location than at the location of split-spoon sampling. See location diagram									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL	WS OR WD	BORING STARTED 10-10-74	SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 APPROVED BY REZ STS JOB NO. 17530-A
WL	BCR ACR	BORING COMPLETED 10-10-74	
WL	RIG SB FOREMAN JD		

OWNER U.S. Steel Corporation					LOG OF BORING NUMBER Approximately 800' B-3 East of North Slip				
PROJECT NAME North & South Slip Bottom Sampling					ARCHITECT-ENGINEER				
SITE LOCATION South Works Plant, Chicago, Illinois					<div style="text-align: center;"> </div>				
ELEVATION DEPTH	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY					
SURFACE ELEVATION									
10.0					Water (temp 15°C)				
20.0									
25.11					End of Boring				
Bottom materials - two types - gray-brown, silty fine sand and gray-black clay.					Because of inability to secure barge no samples of natural materials could be recovered.				
Water samples were recovered at depths of 5, 15 and 25'. See Location Diagram.									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL	WS or WD	BORING STARTED 10-10-74	SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062	
WL	BCR	ACR		
WL			RIG SB FOREMAN JD	APPROVED BY REZ STS JOB NO. 17530-A

OWNER U.S. Steel Corporation					LOG OF BORING NUMBER North Slip 23+25' - 60' B-4 from South Side				
PROJECT NAME North & South Slip Bottom Sampling					ARCHITECT-ENGINEER				
SITE LOCATION South Works Plant, Chicago, Illinois					○ UNCONFINED COMPRESSIVE STRENGTH TONS/FT. ² 1 2 3 4 5 PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % X ○ △ 10 20 30 40 50 ⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50				
ELEVATION DEPTH	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT. ³			
⊗					SURFACE ELEVATION				
10.0					Water (temp 17°C)				
20.0									
30.0									
37.3	SS				See Note Silty clay, trace sand & fine gravel - gray - hard (CL-ML) $Q_p=4.5+$				
					End of Boring	*Calibrated Penetrometer			
NOTE: The composite water samples were recovered at depths of 5, 15 and 25' at three locations. See location diagram. No soft bottom materials were encountered. The clam bucket recovered broken concrete, sand, gravel & clay.									
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU, THE TRANSITION MAY BE GRADUAL.									
WL	WS OR WD	BORING STARTED		10-10-74	SOIL TESTING SERVICES, INC.				
WL	BCR	ACR	BORING COMPLETED		10-10-74	111 PFINGSTEN ROAD			
WL			RIG	SB	FOREMAN	JD	APPROVED BY		REZ
							NORTHBROOK ILLINOIS 60062		
							STS JOB NO. 17530-A		

OWNER U.S. Steel Corporation					LOG OF BORING NUMBER North Slip - 7+50' B-5 70' from North Side					
PROJECT NAME North & South Slip Bottom Sampling					ARCHITECT-ENGINEER					
SITE LOCATION South Works Plant, Chicago, Illinois					<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>○ UNCONFINED COMPRESSIVE STRENGTH TONS/FT.²</p> <p>1 2 3 4 5</p> </div> <div style="width: 45%;"> <p>PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT %</p> <p>✕ ----- ○ ----- △</p> <p>10 20 30 40 50</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> <p>⊗ STANDARD PENETRATION</p> <p>10 20 30 40 50</p> </div> <div style="width: 45%;"> <p>BLOWS/FT.</p> <p>10 20 30 40 50</p> </div> </div>					
ELEVATION	DEPTH	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE						RECOVERY
SURFACE ELEVATION										
10.0						Water - temp 18°C				
20.0						Soft black bottom materials - free fall of drilling rods				
30.0										
35.4			SS			<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Silty, sandy clay, trace fine gravel Matrix is slightly cemented - gray hard (CL-ML) Qp-7ton+</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">End of Boring</div>				<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">*Calibrated Penetrometer</div>
<p>NOTE: The composite water samples were recovered at depths of 5, 15 and 19' at three locations. See location diagram.</p>										
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.										
WL		WS OR WD		BORING STARTED 10-10-74		SOIL TESTING SERVICES, INC.				
WL		BCR		ACR		BORING COMPLETED 10-10-74		111 PFINGSTEN ROAD		
WL				RIG SB		FOREMAN JD		APPROVED BY REZ		STS JOB NO. 17530-A

4 1/2" 370+